REMARKS

Claims 1-7 and 9-17 have been amended. Claims 18 and 19 have been added. Claim 8 has been canceled without prejudice. Subsequent to the entry of the present amendment, claims 1-6 and 7-19 are pending and at issue. These amendments and additions add no new matter as the claim language is fully supported by the specification and original claims.

Applicants also gratefully acknowledge that claims 2, 6, 7 and 11-17 would be allowable if amended to overcome the rejection under 35 U.S.C. § 112, first and second paragraphs and to include all the limitations of the base claim and any intervening claims. All claims have been amended and new claims 18-19 have been added. The claim amendments make clear the metes and bounds of the invention and the subject matter claimed remains substantially the same.

I. <u>Amendment to the Claims</u>

Claims 1-7 and 9-17 have been amended. Claim 8 has been canceled. New claims 18 and 19 have been added. Also claims 11-17 and 19 have also been amended to depend on claim 18, a solder composition, and not claim 10, an alloy composition. Claim 1 recites:

> A solder composition for assembling, repairing or sizing jewelry comprising of about 25% to 92% by weight gold and about 2% to 14% by weight of an alloy consisting of gallium, indium, and copper in a respective weight ratio of approximately 6:3:1 respectively, wherein the solder composition has a melting temperature in a range from about 1000°F to about 1550°F.

Claim 10 recites:

> An alloy for lowering the melting point of a gold solder comprising about 2% to 14% by weight gallium, indium and copper in a respective weight ratio of approximately 6:3:1, wherein the solder has a reduced melting temperature as compared to a solder not having the alloy.

New claim 18 recites:

> A gold solder composition comprising of about 25% to 92% by weight gold and an alloy for lowering the melting point of the solder comprising about 2% to 14% by weight gallium, indium and copper in a respective weight ratio of approximately 6:3:1.

The claims have been amended to better define the metes and bounds of the claimed invention. The amendments are fully supported in the specification and originals claims as filed. For example, claim 10 has been amended and recites the phrase "wherein the solder has a reduced melting temperature as compared to a solder not having the alloy". This phrase is not new matter because it is considered inherent, since one skilled in the art of jewelry making will understand that commercial solders at the time of filing of the application, and even to date, have higher melting temperatures than the claimed invention (see also Exhibit A & B). Thus, no new matter has been added.

II. Rejection under 35 U.S.C. §112, First Paragraph (enablement)

Claims 1-4, 8-13 and 17 are rejected under 35 U.S.C. §112, first paragraph, as allegedly containing subject matter not described in the specification in such a way as to enable one of skill in the art to make or use the invention. Claim 8 has been canceled and the subject matter of which has been incorporated into claim 1. Hence, the rejection is moot with regards to claim 8. Applicant traverses this rejection as it applies to the amended claims and new claims.

According to the Office Action, the specification fails to enable any skilled in the art to make or use the invention commensurate in scope the claims because independent claim 10 is directed to an alloy containing 2-14% total Ga, In and Cu, but that it is allegedly unclear what other elements can make up the majority of the composition. Further, although the Office Action refers to only claim 10, Applicants have interpreted this to also apply to independent claim 1 since claims dependent on claim 1 are also rejected.

The amendments to claims 1 and 18 above make clear what other elements can make up the majority of the composition (claim 1), or makes clear the claimed invention is a gallium, indium and copper alloy which when added to a gold solder at about 2% to 14% in a 6:3:1 ratio, reduces the melting temperature of the gold solder (claims 10). Further, Examples 6-13 of the

specification provide working examples and sufficient guidance commiserate in scope with the claimed invention, and in such a way as to enable one of skill in the art to make or use the invention without undue experimentation.

Accordingly, withdrawal of rejection of claims 1-4, 9-13 and 17 under 35 U.S.C. § 112, first paragraph is respectfully requested.

III. <u>Rejection under 35 U.S.C. § 112, Second Paragraph</u>

Claims 1-17 are rejected under 35 U.S.C. § 112, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 8 has been canceled and the subject matter of which has been incorporated into claim 1. Hence, the rejection is moot with regards to claim 8. Applicant traverses this rejection as it applies to the amended claims.

According to the Office Action, the following is allegedly unclear and indefinite: i) the phrase "gold-based" solder in claim 1; ii) the Markush grouping of the alloy in claim 1; iii) the temperature should be in Celcius and not in Fahrenheit; and iv) whether claim 10 is directed to an alloy or a gold solder.

Claims 1-7 and 9-17 have been amended. New claims 18 and 19 have been added. Claim 1 has been amended as discussed above. Claim 1 has been amended so that it recites a "gold solder" and not a "gold-based solder". Claim 1 has also been amended such that the elements of the alloy are not in a Markush group.

With regards to the temperatures recited in the claims, they are correctly recited in degrees Fahrenheit (°F) and not Celcius as indicated in the Office Action. Exhibits A and B demonstrate that the claimed temperature range (1000°F to 1550°F) is within the temperature range found in the art using other commercially available gold solders. Exhibit A shows various plumb gold

solders from http://www.hooverandstrong.com/mill/plumbgold_solder.htm; Exhibit B is an article from Gregg Todd in *AJM* (The Authority On Jewelry Manufacturing), published July, 2005, issue, page 41.

Todd discloses that solders should have flow temperatures below (or lower) than that of the actual karat alloy (see pages 48-49 and tables therein which describe melting temperatures in both Fahrenheit and Celsius). Todd discloses that of the 129 commercial solders analyzed, all have melting, flow, or "liquidus" temperatures ranging from 1134°F to 1690°F (or 612 °C to 921°C). Although the claimed temperature range overlaps that disclosed in Todd, the melting, flow or "liquidus" temperatures of the claimed invention (1000°F to 1550 °F) are lower than that of the commercial solders analyzed by Todd. The claimed temperature range is also lower than that shown in Exhibit A. Thus, the claimed solders contain an alloy which reduces the melting temperatures of the solders, but which temperatures are not "far too low" as alleged by the Office Action (page 3, part (c)).

Claim 10 has been amended to recite an alloy containing gallium, indium and copper in a 6:3:1 ratio, respectively. Such alloy when added to a gold solder in amounts of about 2% to 14% by weight will reduce the flow, melting, or liquidus temperature of the solder. New claim 18 has been added and is directed to a gold solder with an alloy which reduces the temperature of the solder. Claims 11-17 been amended to depend on new claim 18. Similarly, new claim 19 depends on claim 18.

Therefore, the amendments to the claims particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Accordingly, withdrawal of rejection of claims 1-17 under 35 U.S.C. § 112, second paragraph is respectfully requested.

IV. Rejection under 35 U.S.C. § 103(a)

Claims 1, 3-5 and 8-10 are rejected under 35 U.S.C. §103(a) as allegedly being obvious over U.S. Patent No. 4,591,483 to Nawaz (hereinafter, "Nawaz"). Claim 8 has been canceled and the subject matter of which has been incorporated into claim 1. Hence, the rejection is moot with regards to claim 8. Applicant traverses this rejection as it applies to the amended claims and new claims.

Claim 1 has been amended as discussed above. Nawaz discloses a "dental" alloy and not a "solder" as in the claimed invention. Further, the Office Action admits that Nawaz does not disclose the about 2% to 14% of the gallium, indium and copper alloy in a 6:3:1 ratio as recited in the claimed invention (see claims 1, 10 and 18). Also, the melting intervals disclosed in the Nawaz are in degrees Celcius and not in degrees Fahrenheit. The corresponding Fahrenheit temperatures disclosed in Nawaz are significantly higher than the range as recited in the claimed invention because Nawaz' "dental" alloys contain palladium which has a higher melting temperature (about 2830 ^{o}F). In contrast, the claimed invention is a gold solder containing no palladium. Thus, Nawaz does not make obvious the claimed invention because Nawaz does not teach the claimed solder, alloy and within the melting temperature range.

Accordingly, withdrawal of rejection of claims 1, 3-5 and 8-10 under 35 U.S.C. § 1103, first paragraph is respectfully requested.

V. Double patenting rejection

Claim 10 is rejected under the judicially created doctrine of obviousness-type double-patenting as being allegedly unpatentable over claim 12 of U.S. Patent No. 6,372,060 to Weinstein.

A Terminal Disclaimer, disclaiming any patent term of the subject application that may extend beyond the term of U.S. Patent No. 6,372,060, is submitted herewith. Accordingly, it is respectfully requested that the double patenting rejection be withdrawn.

Conclusion

In view of the amendments and above remarks, it is submitted that the claims are in condition for allowance, and a notice to that effect is respectfully requested. The Examiner is invited to contact Applicant's undersigned representative if there are any questions relating to this application.

A check in the amount of $65.00 is enclosed as payment for the Terminal Disclaimer fee. No other fee is deemed necessary in connection with the filing of this paper. However, the Commissioner is hereby authorized to charge any fees required by this submission, or credit any overpayments, to Deposit Account No. 07-1896 referencing the above-identified docket number. A duplicate copy of the Transmittal Sheet is attached.

Respectfully submitted,

Lisa Haile

Date: January 4, 2006

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Plumb Gold Solde

Hoover & Strong plumb gold solders comply with the Gold and Silver Stamping Act Amendments. No minus tolerances. Our white gold, platinum and silver (H4-45 to H8-80) solders do not contain cadmium.

Solder	Karat	Melt Pt	Flow Pt	Recommmende
10K Yellow Hard	10K	1290°F	1425°F	sizing/fabrica
10K Yellow Medium	10K	1225°F	1270°F	sizing/2nd f
10K White Hard	10K	1310°F	1395°F	sizing/fabrica
10K Pink Hard	10K	1700°F	1735°F	sizing/fabrica
10K Green Hard	10K	1380°F	1535°F	sizing/fabrica
14K Yellow Hard	14K	1375°F	1460°F	sizing/fabrica
14K Yellow Medium	14K	1345°F	1440°F	sizing/2nd fab/ti
14K Yellow Easy	14K	1305°F	1415°F	sizing/chain re
14K Yellow Extra Easy	14K	1105°F	1255°F	fine chain rep
14K White Hard	14K	1350°F	1440°F	sizing/fabrica
14K White Medium	14K	1300°F	1330°F	sizing/2nd f
14K White Easy	14K	1240°F	1290°F	sizing/3rd f
14K Pall White Hard	14K	1360°F	1460°F	sizing/fabrica
14K Pink Hard	14K	1655°F	1680°F	sizing/fabrica
14K Green Hard	14K	1290°F	1450°F	sizing/fabrica
14K Peach Hard	14K	1485°F	1600°F	sizing/fabrica
18K Yellow Hard	18K	1420°F	1525°F	sizing/fabrica
18K Yellow Medium	18K	1345°F	1480°F	sizing/fabrica
18K Yellow Easy	18K	1095°F	1255°F	sizing/3rd f
18K Royal Yellow	18K	1430°F	1535°F	sizing/fabrica
18K White Hard	18K	1395°F	1445°F	sizing/fabrica
18K Pall White Hard	18K	1785°F	1840°F	sizing/fabrica
18K Pink Hard	18K	1350°F	1525°F	sizing/fabrica
18K Green Hard	18K	1495°F	1560°F	sizing/fabrica
20K White Hard	20K	1565°F	1615°F	sizing/tippi
21K Yellow Hard	21K	1530°F	1660°F	sizing/fabrica

STANDARD PROCEDURE

Original research into standardizing the designation of karat gold solders

By Gregg Todd

Joe Torch, a veteran bench jeweler, had been ordering alloys and solder from Hot Shot Metals since 1980. He felt like a regular at Cheers when he walked in to drop off his scrap for refining and the small staff would chime, "Torch!" You can imagine his dismay when Hot Shot owner Ralph Fine announced that he was retiring and the company was closing its doors after 30 years in business. Torch was going to miss the staff, the service, and, perhaps most important to his own business, the solder.

Torch had been using Hot Shot's solder and alloys for years. He could practically weld a head to a shank with his eyes closed. But now, his confidence in pairing the right solder with the right job had taken a turn, as he found himself fumbling a job here and there when the gold flowed before the solder. If only he had some type of system to consult when matching solders and alloys...

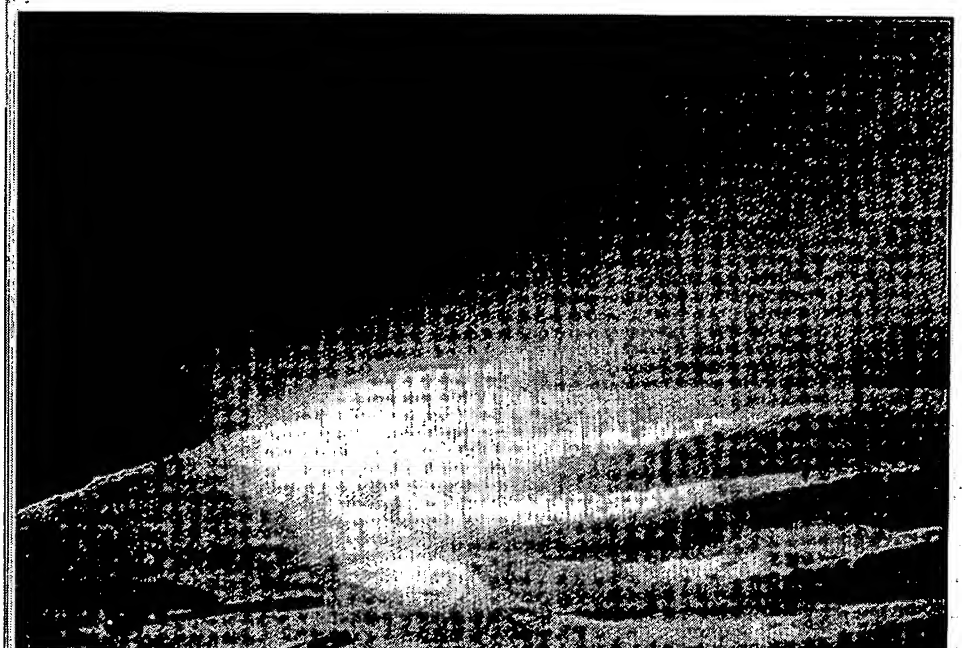
IT'S A PROBLEM that plagues the jewelry industry: a lack of uniform standards for designating karat gold solders. Typically, a manufacturer will independently develop a family of gold solders and compare the melting points of each. The manufacturer will assign a designation to the solder with the lowest melting point (i.e., extra easy, ultra easy, extra soft, etc.), and then assign the opposite designation to the solder with the highest melting point (i.e., hard, seamless, weld, etc.). The remaining solders will be slotted according to their relative relationships.

However, this system creates problems for the bench jeweler who chooses solders from different manufacturers or uses different karat or color combinations while step soldering. Such problems are usually resolved through trial and error, but this is often at the cost of damaged items.

In this article, I am suggesting a better system for designating solders, based on a universal temperature scale that everyone can understand. Such a system would enable bench jewelers to order a solder from any manufacturer and know that its liquidus temperature would fall within a specific range for a specific designation.

The first step in developing such a scale is to establish the relationship between solder and metal substrates. Currently, designations such as "hard" or "soft" refer only to how the liquidus temperatures (flow points) differ within a particular family of solders. But knowing a solder's flow point and how it relates to the melting range of the metal is critical; it will determine whether two items can be successfully joined by that solder. Since we want the solder to melt and flow *before* the metal substrates do, it is most logical to base the scale on the temperature difference between the solidus temperature of the karat metal and the liquidus temperature of the solder. Based on this, I developed the following framework for the proposed scale:

> KNOWING A SOLDER'S FLOW POINT AND HOW IT RELATES TO THE MELTING RANGE OF THE METAL WILL DETERMINE IF THE TWO ITEMS CAN BE JOINED SUCCESSFULLY.



- Solders that have liquidus temperatures within 25°F (14°C) of the melting point of the karated metal would be designated as weld solders. The weld designation would indicate some melting of the substrate material, involving mutual solubility between the solder and the substrate materials, with a high degree of diffusion at the interface. The joint could not be separated by reheating. Weld solders should be used when a permanent joint with maximum strength is required.

- Solders that have flow points 26°F to 95°F (15°C to 53°C) below the melting point of the karated metal would be designated as hard solders. The hard solder designation would indicate that there is mutual solubility between the solder and substrate materials, involving a moderate degree of diffusion of material across the liquid/solid interface. Depending on where in the temperature range the flow point falls, separation of the joint through reheating may be extremely difficult.

In the World Gold Council's *Handbook on Soldering and Other Joining Techniques*, metallurgical consultant Mark Grimwade of Middlesex, England, states that "ideally there should be a difference of at least 50°C between the temperature at which the solder is completely molten and will flow and the solidus temperature

PHOTOS BY GREG GILMAN

of the parent metal, in order to avoid incipient melting of the component pieces." This guideline can be used to determine when hard solder joints could be separated, if necessary, by reheating. (This temperature relationship is far more crucial with torch soldering than in oven soldering applications, where the temperature can be tightly controlled and more evenly applied.) Hard solders should be used where a permanent joint is required and incipient melting of the substrate can be tolerated as long as it is kept to a minimum.

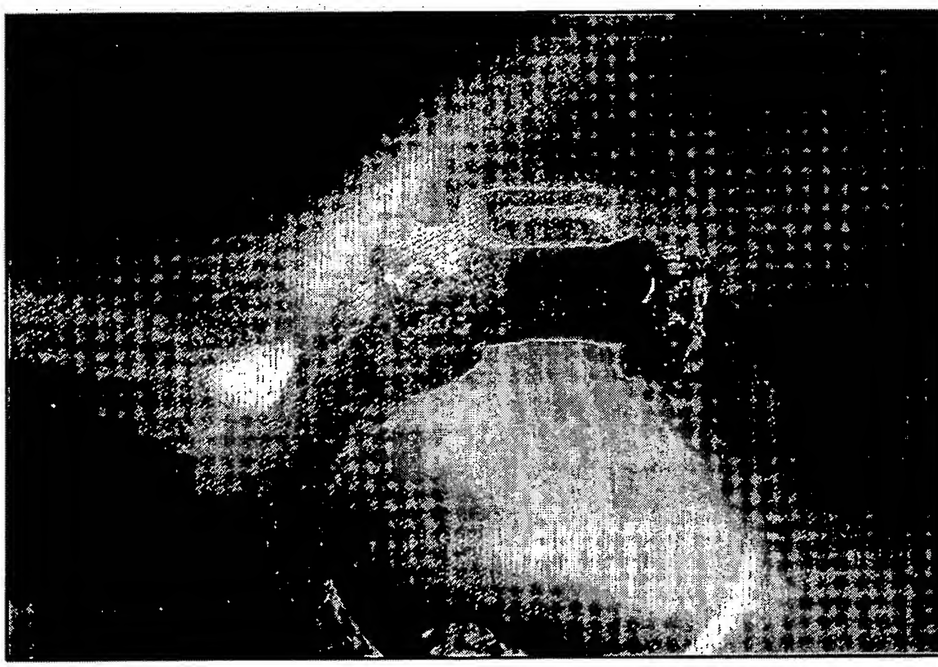
• Solders with flow points 96°F to 145°F (54°C to 80°C) below the melting point of the karated metal would be designated as medium solders. The medium designation would indicate a strong mechanical bond, with a minimal degree of diffusion on the atomic scale across the liquid/solid interface. This joint could be successfully separated through reheating.

• Solders with flow points 146°F to 195°F (81°C to 108°C) below the melting point of the karated metal would be designated as easy solders. The easy designation would indicate a moderately strong mechanical bond, with negligible diffusion of material across the liquid/solid interface. This joint could be separated readily through reheating.

• Any solders with flow points 196°F (109°C) or more below the melting point of the karated metal would be designated as extra, ultra, or super easy solder. The extra easy designation would indicate a bond with the least amount of diffusion across the liquid/solid interface and that could be separated easily by reheating.

Although temperature is the most easily recognized factor in soldering, it is important to acknowledge that temperature alone is not the only consideration in the behavior of solder with the substrate. In practical application, the wetting and spreading characteristics of the solder cannot be overlooked. As David Jacobson of Buckinghamshire Chilterns University College in High Wycombe, UK, points out, "The wetting and spreading characteristics at the temperature of use (which may be prescribed by the solidus temperature of the parent material) are the key issues here and they depend on composition no less than on temperature."

It's equally important to acknowledge that the wetting and spreading characteristics of solder are affected by the composition of the substrate as well, since karated metals can include a range of alloys (such as palladium or nickel in white golds) formulated to produce variations within a karat/color range.

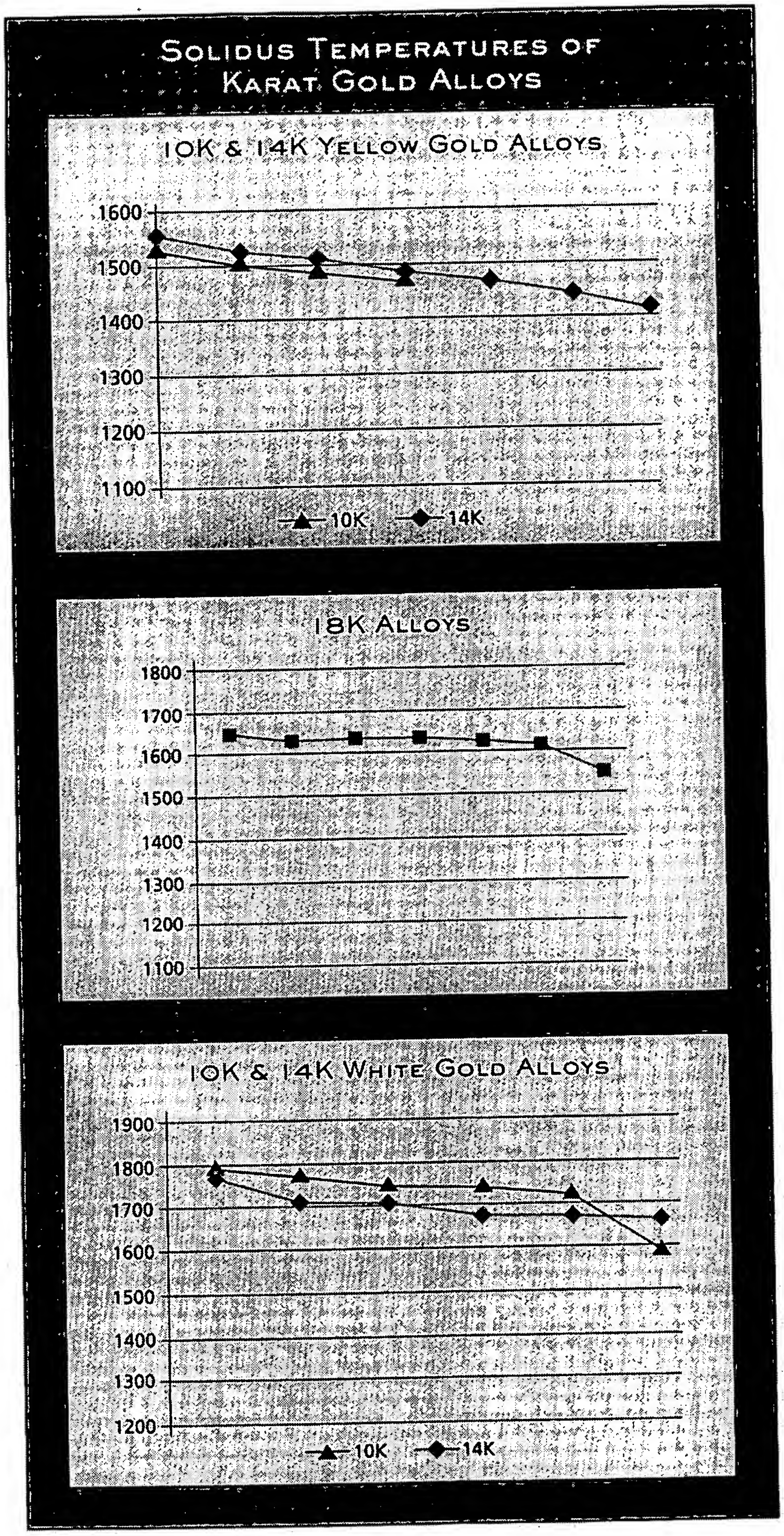


THE PURPOSE OF THIS RESEARCH IS TO STANDARDIZE THE DESIGNATION OF SOLDER FOR THE BENEFIT OF THE BENCH JEWELER.

However, if we were to attempt to develop parameters for the designation of solder that factor in every conceivable variable and combination for solder and gold alloys, we could easily find ourselves with a tremendous amount of good information that has little practical application. Therefore, users of these designations should understand that an individual solder will not necessarily behave identically at the same temperature on two different karat gold alloys.

PROCEDURE

The proposed system designates solders based on the difference between the substrate's solidus temperature and the solder's liquidus. However, different karat alloy formulas have different solidus tem-



peratures. For this reason, I had to determine a benchmark number that could be used to represent the karat grouping—which became my second major challenge in this project.

Given the wide range of karat alloy formulas from different manufacturers, I realized that as soon as a temperature was identified as a benchmark, some manufacturer would say that temperature did not match the system it currently used. But since no single manufacturer's set of standards can be adopted as a universal benchmark, I focused on determining a reasonable temperature that could represent a given group of karat alloys.

The first step was to gather accurate solidus and liquidus temperatures of karat gold alloys and solders. Associates in the technology department at Stuller used a differential scanning calorimeter, which measures temperatures and heat flows associated with thermal transitions in a material, to gather this information.

Thermal data was collected from 32 different karat gold alloy combinations to begin building the benchmark number. Single samples of red and green alloys, along with a single 22 karat alloy, were dropped from the reference list because the available samples were too few to be objective, reducing the total alloy combinations to 25. The final reference list included six 10k alloys, 12 14k alloys, and seven 18k alloys. When broken down by color, there were 15 yellow alloys and 10 white alloys.

KARAT GOLD DATA

The thermal data was then grouped according to karat/color combinations, and a solidus temperature range was determined.

- The solidus temperature range for 10k yellow alloys was 1,480°F to 1,525°F (804°C to 829°C), a variation of 45°F.

• The solidus temperature range for 10k white alloys was 1,595°F to 1,790°F (868°C to 977°C), a variation of 195°F.

• The solidus temperatures for the 14k yellow alloys ranged from 1,410°F to 1,545°F (766°C to 841°C), a 135°F range variation. One thing to note here is that there is a 40°F temperature separation between the lowest two solidus temperatures in this group. Most alloys in this group were separated by 30°F or less.

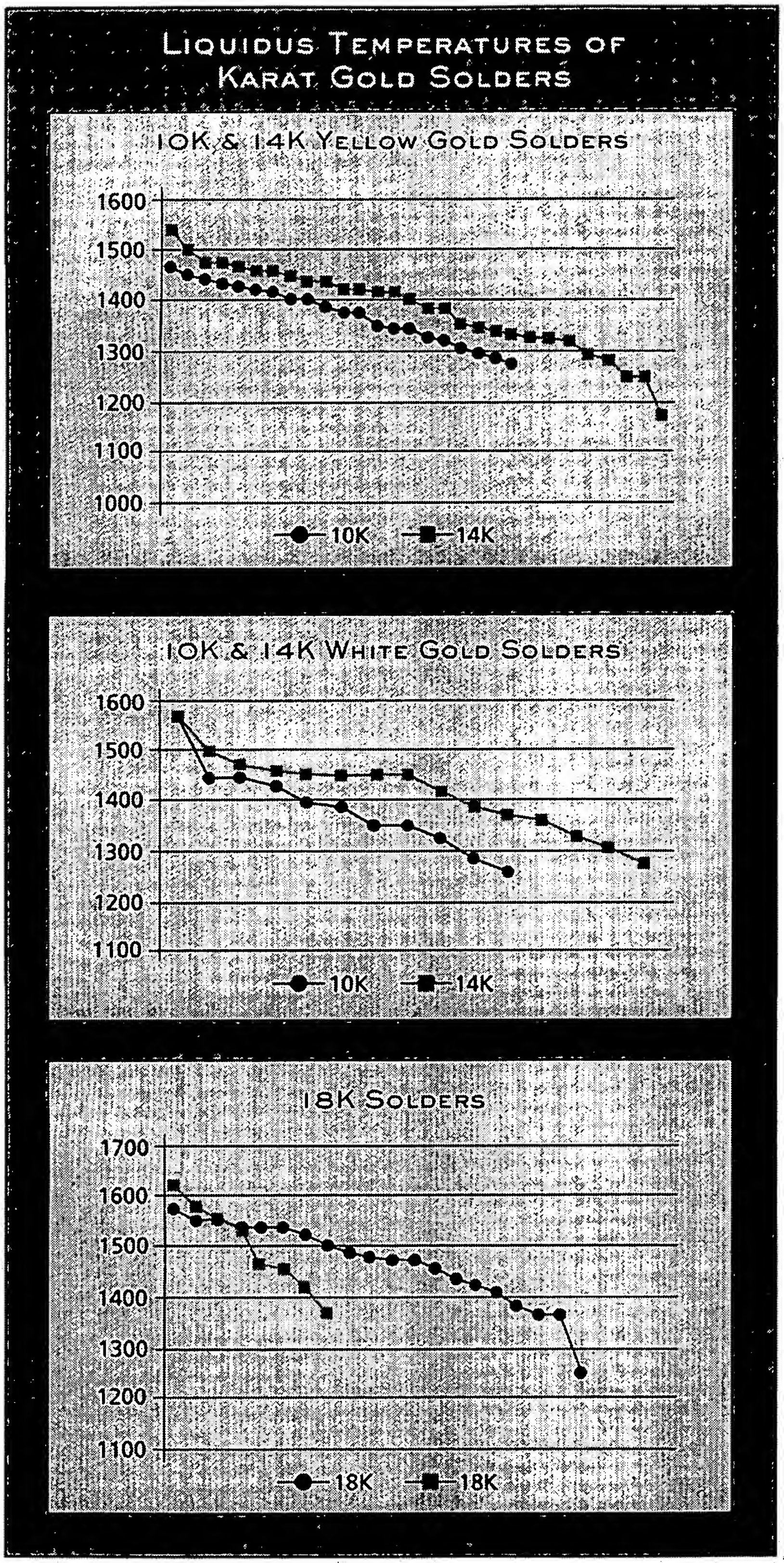
• The solidus temperature range for 14k white alloys was 1,655°F to 1,770°F (902°C to 966°C), a 115°F variation.

• The solidus temperature range for the 18k yellow and nickel-white alloys was 1,585°F to 1,645°F (863°C to 896°C), a 60°F variation. If the solidus temperature range for 18k palladium-white alloys is included, the range extends up to 1,680°F (916°C), bringing the variation to 95°F.

To gather accurate liquidus and solidus temperatures of karat gold alloys and solders, the staff at Stuller used a differential scanning calorimeter, which measures temperatures and heat flows associated with thermal transitions in a material.

Note that the entire solidus range for the 10k yellow alloys is encompassed within the solidus range of the 14k yellow alloys. The solidus range for the 10k alloys extends from 1,480°F to 1,525°F (804°C to 829°C), while the 14k alloys' range is 1,410°F to 1,545°F (766°C to 841°C). This allows the 10k and 14k yellow alloys to share the same benchmark.

The average melting temperature for the 10k and 14k yellow range is 1,491°F. However, this average is below the liquidus temperature of two solders, which signaled that, as a benchmark, this temperature was in all likelihood too low.



When the two lowest melting points were dropped, the average temperature rose to 1,505°F. This number was rounded up to the nearest 10° mark, to 1,510°F, to serve as the benchmark for the 10k and 14k yellow alloy group. Benchmarks were designated in a similar manner for the 10k and 14k white alloy group and the 18k alloy group.

Similarly, in the solidus temperature range for 10k and 14k white alloys, the 14k group falls entirely within the 10k range, allowing these two karats to be grouped together into a single range of 1,595°F to 1,790°F (868°C to 977°C), a 195°F temperature variation.

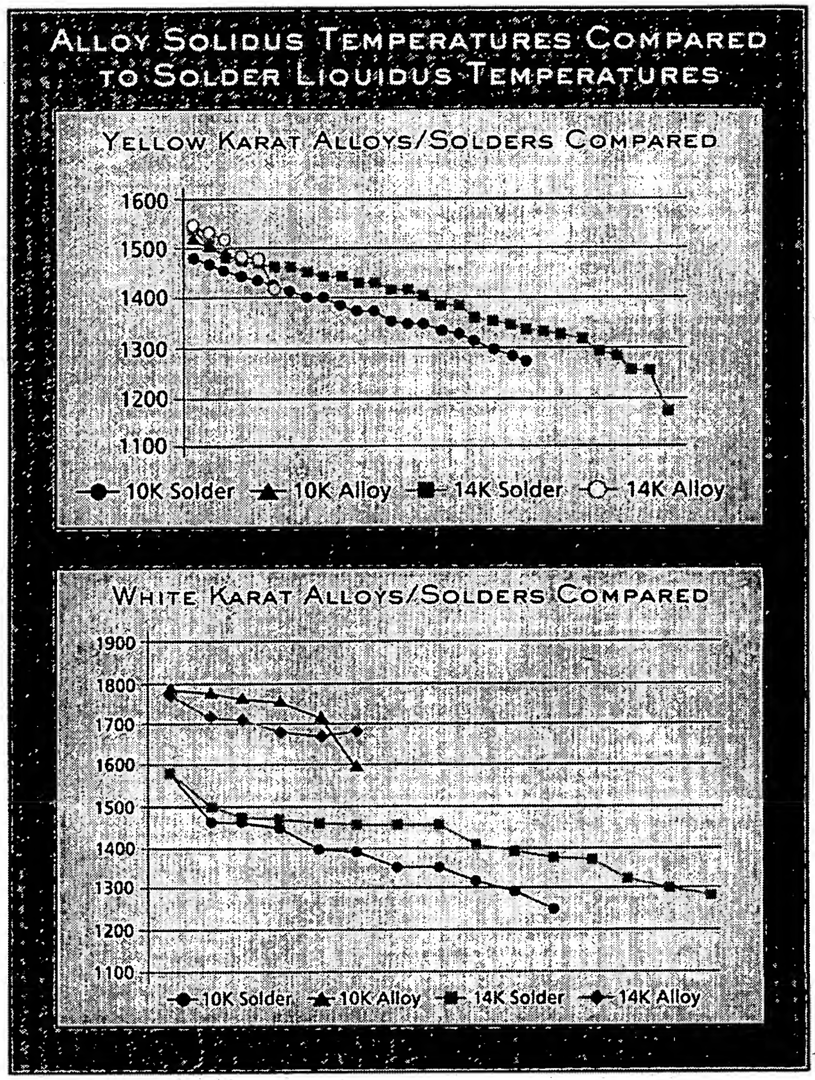
SOLDER DATA

Once I had the karat gold data, my next step was to collect thermal data on 129 commercial solder compositions produced by different manufacturers. The solders were grouped according to karat and color, and further segregated as cadmium or non-cadmium alloys.

The solidus and liquidus values were determined for each individual solder with the same testing procedures used for the karat alloys. The significant value in this case was the liquidus temperature, as we are basing the scale on the temperature difference between the solidus of the karat metal and the liquidus of the solder.

Though there were temperature range differences noted between the cadmium-free and cadmium-bearing solders, they were grouped together in the final charts. The important relationship is between the karated metal and solder used to join it, not the solder formulation.

The relationship between the liquidus temperatures of the solders when grouped by color followed that of the karated alloys. The liquidus range of the 10k yellow solders extended from 1,275°F to 1,475°F (691°C to 802°C) and fell within that of the 14k yellow solders, 1,165°F to



1,540°F (629°C to 838°C).

The 10k and 14k white solders followed the same pattern as the yellow solders, with a slight inversion. The liquidus range of the 14k white solders extended from 1,280°F to 1,570°F (693°C to 854°C) and fell within that of the 10k white solders, 1,260°F to 1,570°F (682°C to 854°C).

In the 18k solder family, the white and yellow solders fell within a similar liquidus range, extending from 1,255°F to 1,625°F (679°C to 885°C).

The next step was to combine the graph for the 10k and 14k yellow alloys with the graph for their respective solders. There is a close clustering of solders and alloys around the top of the respective temperature ranges, but only one 14k yellow solder has a liquidus temperature above 1,510°F (821°C).

On the similar graph for the white alloys, there is a wider separation between the solidus temperatures of the alloys and the liquidus temperatures of the solders. The lowest solidus temperature of this alloy group is 25°F above the highest liquidus temperature of the solders. This was the only grouping where the solder and alloy temperatures did not overlap.

RESULTS

Three tables were created from the collected data: one for 10k and 14k yellow solders, one for 10k and 14k white solders, and one for 18k solders. The tables were originally developed with a 25°F overlap between solder designations to allow more solder manufacturers' current classifications to fit within scale. This, however, perpetuated the ambiguity that presently exists and was at odds with the desired outcome of this research: a defined temperature range for each grade.

In addition, the designation ranges in the final scale below do not match those proposed earlier in this article. After measuring the liquidus temperatures of all the solders in each group, we realized that the range for each group varied, and therefore a standard designation range across the board was not feasible.

The final tables define each grade in temperature ranges that are tailored to each alloy group. The ranges are adjacent to each other and do not overlap. Currently, no manufacturer's solder line fits completely within the temperature range designations identified in this scale. Most of the manufacturers' product lines align with 50 to 60 percent of the designations, and those outside of this range are generally not more than one designation different.

Benchmark temperatures were determined based on the best relational fit according to the solidus temperature of the karat alloys. The benchmark for the 10k and 14k yellow scale is set at 1,510°F (821°C). With the exception of one 14k solder whose liquidus temperature was 60°F above the next closest, all liquidus temperatures for the remaining solders fell below this benchmark.

The benchmark for the 10k and 14k white scale is set at 1,690°F (921°C). This places it 120°F above the highest liquidus temperature for the solders within this group. This scale also has the widest temperature range of the three scales.

The 18k yellow and white scale has a benchmark set at 1,640°F (893°C), the

10K AND 14K YELLOW GOLD SOLDER LIQUIDUS TEMPERATURE RANGE

DESIGNATION	WELD		HARD		MED.		EASY		EXTRA EASY		ULTRA EASY	
Designation Range °F	0	75	76	150	151	225	226	300	301	375	376	Below
Liquidus of Solder °F	1,510	1,435	1,434	1,360	1,359	1,285	1,284	1,210	1,209	1,135	1,134	
Liquidus of Solder °C	821	779	778	738	737	696	695	654	653	613	612	

10K AND 14K WHITE GOLD SOLDER LIQUIDUS TEMPERATURE RANGE

DESIGNATION	WELD		HARD		MED.		EASY		EXTRA EASY		ULTRA EASY	
Designation Range °F	0	100	101	200	201	300	301	400	401	500	501	Below
Liquidus of Solder °F	1,690	1,590	1,589	1,490	1,489	1,390	1,389	1,290	1,289	1,190	1,189	
Liquidus of Solder °C	921	866	865	810	809	754	753	699	698	643	643	

18K YELLOW AND WHITE GOLD SOLDER LIQUIDUS TEMPERATURE RANGE

DESIGNATION	WELD		HARD		MED.		EASY		EXTRA EASY		ULTRA EASY	
Designation Range °F	0	50	51	125	126	200	201	275	276	350	351	Below
Liquidus of Solder °F	1,640	1,590	1,589	1,515	1,514	1,440	1,439	1,365	1,364	1,290	1,289	
Liquidus of Solder °C	893	866	865	824	823	782	781	741	740	699	698	

approximate midpoint of the solidus temperatures for the 18k alloys. This places the scale 15°F above the solder with the highest liquidus temperature within this group.

When looking at the scale, the title is listed across the top row and six separate solder designations are identified on the second row. Since all manufacturers do not use the same terminology to refer to their solders, the designated titles are not as important as the corresponding ranges. (In fact, the industry may want to consider abandoning titles such as "hard" and "easy," and selling solders by temperature range.)

The next row identifies the temperature range within that designation in degrees Fahrenheit from the benchmark number. The fourth and fifth rows identify the liquidus temperature range (in Fahrenheit and Celsius, respectively) for each designation. The first liquidus temperature in each scale is the benchmark for that scale.

Looking at the first scale, the benchmark is 1,510°F (821°C) and the weld designation extends 75°F. This sets the bottom threshold for the weld designation at 1,435°F (779°C). All 10k and 14k yellow solders with a liquidus temperature above 1,434°F would fall within the weld designation. Solders with liquidus temperatures between 1,360°F and 1,434°F (738°C to 779°C) would fall within the hard designation, and so on.

The system is also effective in identifying the behavioral relationship between a solder and karat alloy when moving between scales. Let's say I'm using a white solder to attach a head to a yellow shank. A medium solder toward the lower end of the scale will behave in approximately the same way as a hard yellow solder in the same application.

WHY STANDARDIZE?

For years bench jewelers have been poorly informed about the melting characteristics of the solders and karat gold alloys that they use. This proposal was undertaken for one purpose only: *to standardize the designation of solder for the benefit of the bench jeweler.* Under a standardized designation, the bench jeweler could use solders from a variety of manufacturers and expect similar behaviors across the board. They would be able to select the solder for a specific application based on the strength of the required bond. These tables have been developed with the behavioral relationships between the karat metals and solders used to join them in mind.

> A STANDARDIZED SYSTEM WILL BENEFIT MANUFACTURERS BRINGING NEW SOLDERS TO MARKET.

In addition to making the bench jeweler's life easier, this system will benefit manufacturers when they bring new products to market. They will have a universal system for the designation of solder and a tool that can help to identify gaps within their product lines.

But this is just the starting point: Implementing such a system requires industry consultation and a trial period—and feedback from you! ◆

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